(Mr. Dakyns is responsible for this rather odd translation), "not to speak of the bad example of carelessness to the beholder."

The work is a marvellous display of close and intelligent observation by an enthusiastic sportsman, and will be full of interest to persons of similar taste in the present day. Of course it contains a good deal of "keepers' superstition," very similar to the fancies of the modern keeper, but this, perhaps, adds to the interest; and many more or less brilliant suggestions are made in explanation of facts which seemed to be in need of it. Mr. Dakyns' translation is spirited and, on the whole (to judge from passages chosen at random), accurate; and any sportsman into whose hand the book falls will feel grateful to him for rendering accessible the work of, perhaps, the acutest observer of outdoor life in antiquity.

In turning to Dr. Ogle's translation of some of the minor treatises of Aristotle, we enter the domain of science proper. The translator's name is sufficient guarantee of the excellence alike of introduction, translation, and notes: the work is quite up to the standard of the "Parts of Animals" by the same editor. Shortly, the doctrine contained in the treatises translated rests on the belief that life depends upon heat: the source of this heat was the heart, in which heat was continually being generated by the concoction of food received from the stomach and passed into the heart; and the heat thus generated supplied the place of that which was continually being given off by the body. But life might be destroyed by excess no less than by defect of heat; this excess was provided against by respiration, which cooled the violence of the "fire" in the heart, which always tended to become excessive: in the case of pulmonate animals, the air in the lungs was the means of refrigeration; in the case of branchiates, the water playing upon the gills. Natural death (as distinct from death by disease or violence) was due to the gradual exhaustion of vital heat—an idea at least as clearly defined as the "vital force" of many modern physiologists. The causes of longevity (in these and other treatises) are somewhat vaguely stated, but the correlation of longevity with such characters as large size, high organisation and length of the period of gestation, was observed by Aristotle. These points are, of course, worked out in much greater detail, and the exposition of them by Aristotle cannot here be reproduced at length. The first impression of an ordinary reader will probably be that views so absurd and obsolete are not worth consideration. But on further attention, we find that obsolete though these views may be, yet they were the first step towards a really scientific physiology. The physiology of Plato and Democritus was pure guesswork, or at least only guided by preconceived theories not falling within the range of physiology. It was Aristotle who first saw

> "that the study of function must be preceded by the study of structure, or in other words, that physiology must be based upon anatomy. . . . By insisting on the absolute necessity of anatomical observation, he carried biology at one step from the world of dreams into the world of realities; he set the science on a substantial basis, and may indeed be said to have been its founder, for the same imaginings of his predecessors can hardly be dignified with the name of science."

And, to quote a later passage of Dr. Ogle's introduction:

> "If we perform the difficult task of excluding from our minds all ideas and facts since acquired, we shall find ourselves constrained to admit that in Aristotle's days no better hypothesis could have been devised with which to colligate the facts or supposed facts then available."

And when we consider that such ideas and facts include among others those of chemical combination, the circulation of the blood and the existence of nerves, we shall be surprised to find the difference between the Aristotelian and the modern theories so slight as it is. In fact, as Dr. Ogle shows both in the introduction and notes, a very slight alteration of terminology is often all that is required to convert Aristotle's statements into propositions which would still be accepted as true; and even in their crude form, many of his doctrines (or something very like them) were held by the most advanced scientific men of recent centuries, Harvey himself among others. It is further remarkable that Aristotle should, with the extremely inadequate instruments and appliances at his command, have produced results so accurate in the region of anatomy and embryology: his account, *e.g.* of the lung, is a model of careful description so far as it goes, and the work before us will provide many other instances. Aristotle, of course, had his defects, and his editor points these out frankly: he occasionally (though far less than any other ancient author) took mere hearsay for fact; and he was scarcely alive to the importance of experiment. But he had a definite method of investigation; his conclusions were always based on recorded observations of himself and others; the advance he made was almost incredibly great for one man; and the lines he laid down have been (though unconsciously) followed and developed by all great physiologists ever since. To quote Dr. Ogle once more:

> "There are minds to which the mistakes and shortcomings of great men apparently present greater attraction than their achievements. To them Bacon is but a man who believed in the spontaneous generation of mistletoe; Cuvier, an upholder of the fixity of species; Kepler, one who thought that the huge volcanoes in the moon were artificial structures built by its inhabitants; Descartes, an asserter of the immediate transmission of light; and Newton himself an advocate of the emission theory. To such persons Aristotle's anatomical statements will doubtless supply much desirable pabulum. But those more genial critics who prefer to dwell upon what a man has done well rather than what he has left undone or done amiss . . . will admit that never has a science been started on its career by its originator with so large an equipment of facts and ideas as that with which Comparative Anatomy left the hands of Aristotle."

THE MEASUREMENT OF RAPIDLY VARYING ELECTRIC PRESSURE.

The Capillary Electrometer: its Theory and Practice. Part i. By G. J. Burch, M.A. Pp. 54. Reprinted from the *Electrician.* (London: G. Tucker.)

MUCH of the present knowledge concerning the capillary electrometer is due to the author of this little book. The instrument was invented in 1875 by Prof. Lippmann, but for twenty years it was hardly used

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by any people except physiologists, and even by them only in a doubtful sort of way, for they thought that its indication gave merely the period and direction of a sudden change of P.D., and they feared that the magnitude of the variation could not be deduced from the excursion of the meniscus formed at the junction of the threads of mercury and dilute sulphuric acid.

It may be well to mention that we use the letters "P.D.," not merely because they appear to us to be a convenient abbreviation for "potential-difference," but because Mr. Burch, by employing them throughout his book, shows that he has the same opinion.

The book commences with a description of the best methods of constructing a capillary electrometer to which the author's experience has led him, and the reader is warned regarding the faults which he is likely to meet with in the practical use of the instrument, and instructed how to overcome those that can be remedied without making a new instrument.

The first two points that Mr. Burch determined to ascertain experimentally, when he began his work on the capillary electrometer in 1886, were: (1) Does any current pass through the instrument after the meniscus in the capillary tube has reached its stable position for the particular P.D. applied; and (2) does any leakage take place through the instrument if the applied P.D. be withdrawn after the meniscus has been deflected? To each of these questions experiment gave a negative answer, and he was, therefore, led to the conclusion that, although the circuit of a capillary electrometer is composed entirely of conducting substances, and, although there is no visible insulating dielectric, the instrument transmits no current with a P.D. of less than 0·5 volt, but merely receives and maintains a charge as if it were a well-insulated condenser.

The capacity of different capillary electrometers was found by the author to vary between 0·1 and 30 microfarads, but instruments having a capacity of between 0·5 and 2 microfarads gave the best results. When the capacity is unchanged on moving the mercury thread through a considerable portion of the capillary tube the electrometer is found to be equally sensitive throughout that part of the tube.

The author concludes that this instrument is essentially adapted to the poor man, since its cost, including that of the microscope, is less than that of any other electrometer of the same sensibility. It also has the advantage of responding with extreme rapidity to every change of potential.

Various methods are described in detail for obtaining records on photographic plates, having a rapid linear or circular motion, and the author shows how the instantaneous value of a rapidly varying P.D. can be deduced at any point of the photographic curve from the fact, which he proves, viz. that the value of the applied P.D. is measured at any moment by the instantaneous distance of the meniscus from the zero position *plus* the rate of motion of the meniscus at that moment. And in the case of the photographic plate moving circularly, he points out that the second term, depending on the instantaneous value of the velocity of the meniscus, is given by the length of the subnormal to the curve at the particular point.

The book concludes with some interesting examples of curves obtained with telephones, direct and alternate current dynamos, &c., from which the value of the capillary electrometer may be clearly seen.

The reasoning in some parts of the book is not very clear; and, while the figures of the parts of the apparatus itself are in many cases bold and well executed, those illustrating the geometrical reasoning, and the results obtained with the photographic plates, are not as intelligible as one would like. We hope to see Part ii. of this book at an early date; and, for the benefit of those who do not resemble the author in being masters in the use and the theory of the capillary electrometer, we trust that he will not hesitate to sacrifice compression to clearness.

W. E. A.

OUR BOOK SHELF.

A Handbook to the Geology of Cambridgeshire, for the Use of Students. By F. R. Cowper Reed, M.A., F.G.S. 8vo. Pp. x2 + 76. (Cambridge: at the University Press, 1897.)

THE geology of Cambridgeshire possesses a special interest for many students. From Cambridge itself there have sprung a greater number of expert British geologists than from any other seat of learning in this country. Though founded by John Woodward, the school was created by Sedgwick; and it has been carried on with signal success by Prof. Hughes. This success, as the present Professor has cordially acknowledged, is partly due to the band of brilliant assistants he has gathered around him. Thus special instruction is given in all branches of geology, and the author of the present work has during recent years rendered aid in the department of stratigraphical palæontology. To a casual visitor the scenery and geology of Cambridgeshire may offer but few attractions, for the country is mostly low-lying, and there is much clay-land and fen. Oxford affords a greater variety of scenery and a more attractive series of fossiliferous formations. Nevertheless, there is much in Cambridgeshire geology to arouse interest when once an enthusiasm for the science has been kindled, and there was need of a concise handbook which should clearly describe and explain the leading facts that have been made known. The excellent "Sketch" by Prof. Bonney dates back to 1875, and the more detailed geological survey memoir on the neighbourhood of Cambridge, by Penning and Jukes-Browne, was issued in 1881. The present work is a model of what a county geology should be. The zones in the Jurassic and Cretaceous rocks, the phosphatic nodules in Lower Greensand and Chalk, the glacial deposits, valley-drifts, and recent accumulations, are all duly described and accompanied by full records of the fossils. If we find fault at all, it is that the author has entered at too great a length into certain contrary views regarding the formation of the Chalky Boulder Clay, for the extraordinary "diluvial theory," as he himself admits, "finds few supporters at the present time." Even the view of S. V. Wood, jun. (noted on p. 168), was modified in that geologist's latest publication.

Our author rightly wanders a little out of the county to give some account of the Red Chalk of Hunstanton, because it is so frequently visited by Cambridge students.

Brief chapters are given on the antiquity of man and on water supply. With regard to the latter subject, we would question the statement (quoted by the author) that "if the Oxford Clay was pierced we might reasonably expect an abundant supply of water." The outcrop of Lower Oolites is some distance away, while at St.

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